LATHE ATTACHMENT FOR GEAR MANUFACTURING

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ABSTRACT

The importance of manufacturing process is that without it no product reach to customer satisfaction. Hence for the Engineers it is importance to covert design into actual product and this one possible only when we go through suitable manufacturing process. Hence manufacturing process is value addition process in which raw material gets converted into finished goods. Gear is important element of mechanical power transmission. It is manufactured by many process such as casting, milling, Hobbing and shaping. All these Manufacturing having its own importance. Among these manufacturing milling is preferred most for job or small amount of production. This milling machine is costly so we have making a new attachment which make gear when installed on lathe carriage. This one is cheap device hence avoids dependency on costly milling machine for job production.

Keyword: - *Gear Manufacturing, Lathe Machine, Dividing Head, Standard Gear, Disc type cutter*

1. INTRODUCTION

In older days, gears are making by the casting method. Then these days, for making gears, cutting splines on shafts, fluting drills, taps and reamers manufacturers use simple and manual indexing method consist by milling machines. If the employers have not milling machine, then he could not be made the gears. But he made the gears on his lathe machine for small attachment of DIVIDING HEAD. When in need of small gears for experimental or model machines the amateur usually purchases them, never thinking that he could make them on his own lathe. A small attachment can be made to fasten in the tool post of a lathe and attachment made to take a mandrel on place the blank for cutting a gear. Here we project on the mass production of gear-blank. Mass Production involves making many copies of products, very quickly, using assembly line techniques to send partially complete products to workers who each work on an individual step, rather than having a worker work on a whole product from start to finish. So we can get complete idea of mass production of gear blank and design of the Lathe Attachment.

Lathe: The basic principle of the lathe machine is that the work piece is held in any holding device and allowed to rotate about a fixed horizontal axis. Center Lathe: A lathe is a machine tool which rotates the work-piece on its axis to perform various operations such as cutting, knurling, drilling, Thread cutting etc. with tools that are applied to the work-piece to create an object which has symmetry about an axis of rotation Turret Lathe: The turret lathe is a form of metal working lathe that is used for repetitive production of duplicate parts, which by the nature of their cutting process are usually interchangeable. Capstan Lathe: In case of capstan lathe the tailstock is replaced by turret, which is mounted on ram. The ram is mounted on saddle. The saddle and the cross slide may be moved longitudinally or cross wise i.e. parallel or perpendicular to the axis of work piece. Automatic Lathe: Automatic lathes have the basic units of simple lathes: bed, headstock, tool slides, and sometimes a tailstock. In addition, an automatic lathe drives the tools through all the steps of a cycle without operator attention once the machine has been set up. Special Purpose Lathe: Several types of special-purpose lathes are made to accommodate specific types of work. These include wheel lathes, hollow-spindle lathes, and gap-frame lathes Tool Room Lathe: This lathe, the most modern engine lathe, is equipped with all the accessories necessary for accurate tool work, being an individually driven geared-head lathe with a considerable range in spindle speeds.

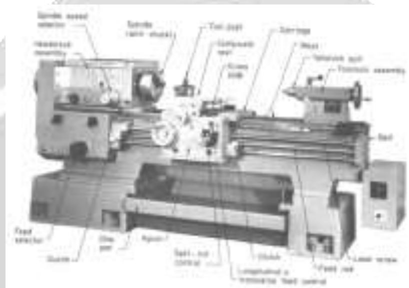

Fig.1 Center Lathe

1.1 Types of Gears: 1. Spur Gear: Spur gears or straight-cut gears are the simplest type of gear. They consist of a cylinder or disk with teeth projecting radially.

2. Helical Gear: Helical gear is curved, this angling makes the tooth shape a segment of a helix. Helical gears can be meshed in parallel or crossed orientations

3. Bevel Gear: A bevel gear is shaped like a right circular cone with most of its tip cut off. When two bevel gears mesh, their imaginary vertices must occupy the same point.

4. Spiral Gear: A spiral bevel gear is a bevel gear with helical teeth. The main application of this is in a vehicle differential, where the direction of drive from the drive shaft must be turned 90 degrees to drive the wheels.

5. Worm and Worm wheel: A worm gear is a species of helical gear, but its helix angle is usually somewhat large (close to 90 degrees) and its body is usually fairly long in the axial direction

6. Rack and Pinion: A rack is a toothed bar or rod that can be thought of as a sector gear with an infinitely large radius of curvature.

7. Internally meshing Gear: In internally meshing of gears the teeth of gears mesh internally with each other as shown in figure. In internal meshing gear the larger gear is called annular wheel and smaller gear is called pinion.

8. Externally meshing Gear: In externally meshing gear, gears the teeth of gears mesh externally with each other. The larger gear is called as wheel and gear is called as pinion.

1.2 Gear Terminology:

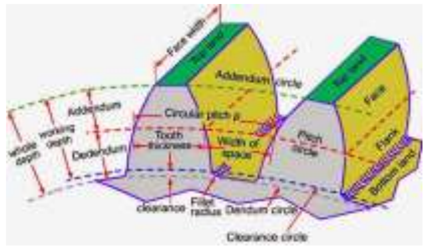

Fig.2 Gear Terminology

1. Pitch Circle: - It is an imaginary circle on gear, by which pure rolling action would transfer the same motion and power as the actual gear. It is the basis of measurement for other parameters of gear.

2. Pitch Circle diameter (D):- It is the diameter of pitch circle. The size of the gear is usually specified by the pitch circle diameter.

3. Pitch point (P):- It is a common point of contact between two pitch circles of mating gears.

4. Module (m):- It is the ratio of the pitch circle diameter to the number of teeth on gear. Mathematically is given by, $m=\frac{D}{T}$ where D= pitch circle diameter of gear, T= Number of teeth on gear.

5. Circular pitch (Pc):- It is circular distance measure along the circumference of the pitch circle from a point of one tooth to the corresponding point on adjacent tooth. Mathematically it is given by $Pc = \frac{\pi D}{T} = \pi m$.

6. Diameter pitch (Pd):- It is the ratio of number of teeth to the pitch circle diameter. Mathematically, it is given by $Pd=\frac{T}{D}$

7. Addendum: - It is the radial distance of tooth from the pitch circle to the top of the tooth. Its standard value is one Module.

8. Addendum circle: - it is the circle drawn through the top the teeth which are concentric to pitch circle.

9. Dedendum: - It is the radial distance of tooth from the pitch circle to the bottom of the tooth. It has a standard value of 1.157m.

10. Dedendum Circle: - It is circle drawn through the bottom of the teeth. It is called as root circle.

11. Clearance: - It is the radial distance between the top of the tooth of one gear to bottom of the tooth of another mating gear. Its standard value is 0.157m.

12. Total Depth: - It is the radial distance between top of the tooth to the bottom of the tooth. It is equal to the sum of the Addendum and Dedendum of a gear.

13. Working Depth: - It is the radial distance from addendum circle to the clearance circle. It is equal to the sum of addenda of two mating gears.

14. Tooth thickness: - It is the width of the teeth measured along the pitch circle. It is equal 1.1578m.

15. Tooth Space: - It is the space between two adjacent tooth measured along the pitch circle.

16. Backlash: - It is the difference between the tooth space and tooth thickness measured along the pitch circle.

17. Face of the Tooth: - It is the surface of the gear above pitch circle.

18. Flank of Tooth: - It is the surface of the gear below pitch circle.

19. Fillet: - It is the curved portion of the tooth flank at the root circle.

20. Top land: - It is the surface at the top of the tooth.

2. Literature Review

[1] Pal et al. Studied on development of a back propagation neural network model for prediction of surface roughness in turning operation and used mild steel work-pieces with high speed steel as the cutting tool for performing a large number of experiments. The authors used speed, feed, depth of cut and the cutting forces as inputs to the neural network model for prediction of the surface roughness. The work resulted that predicted surface roughness was very close to the experimental value. [2] Thamizhmanii et al. Applied Taguchi method for finding out the optimal value of surface roughness under optimum cutting condition in turning SCM 440 alloy steel. The experiment was designed by using Taguchi method and experiments were conducted and results thereof were analyzed with the help of Analysis of Variance method. The causes of poor surface finish as detected were machine tool vibrations, tool chattering whose effects were ignored for analysis. The authors concluded that the results obtained by this method would be useful to other researches for similar type of study on tool vibrations, cutting forces etc. The work concluded that depth of cut was the only significant factor which contributed to the surface roughness [3] Shetty et al. Discussed the use of Taguchi and response surface methodologies for minimizing the surface roughness in turning of Discontinuously Reinforced Aluminium Composites having aluminium alloy 6061 as the matrix and containing 15% vol of silicon Uncoated Carbide Insert particles of mean diameter 25μm under pressured steam jet approach. The measured results were then collected and analyzed with the help of the commercial software package MINITAB15. The experiments were conducted using Taguchi's experimental design technique. The matrix test conditions included cutting speeds of 45, 73 and 101 m/min, feed rates of 0.11, 0.18 and 0.25 mm/rev and steam pressure 4,7,10 bar while the depth of cut was kept constant of 0.5 mm. The effect of cutting parameters on surface roughness was evaluated and the optimum cutting condition for minimizing the surface roughness was also determined finally. A second-order model was established between the cutting parameters and surface roughness using response surface methodology. The experimental results revealed that the most significant machining parameter for surface roughness was steam pressure followed by feed. The predicted values and measured values were fairly close, which indicated that the developed model could be effectively used to predict the surface roughness in the machining of Discontinuously Reinforced Aluminium composites. [4] Govind T Sarkar, Yogesh L Yenarkar and Dipak V Bhope The bending and surface stresses of gear tooth are major factor for failure of gear. Pitting is a surface fatigue failure due to repetitions of high contact stresses. This paper investigates finite element model for monitoring the stresses induced of tooth flank, tooth fillet during meshing of gears. The involutes profile of helical gear has been modeled and the simulation is carried out for the bending and contact stresses and the same have been estimated. To estimate bending and contact stresses, 3D models for different helical angle, face width are generated by modeling software and simulation is done by finite element software packages. Analytical method of calculating gear bending stresses uses AGMA bending equation and for contact stress AGMA contact equation is used. It is important to develop appropriate models of contact element and to get equivalent result using Analysis and compare the result with standard AGMA stress. [5] Krishanu Gupta, Sushovan Chatterjee The principle objective of this paper is the comparison study of the static stresses for spur gear with different pressure angles. The analyzed results of a symmetric type involute profiled spur gear pair at different pressure angles are compared. Gears are one of the most important and crucial component in a mechanical power transmission unit and also in most of the industrial rotating machineries. Generally, a spur gear pair in action undergoes two types of stresses: the bending stress and the contact stress. In this paper, both these stresses on the gear tooth pair are analyzed using the finite element analysis and are compared. The stresses on the gear tooth are first analyzed using finite element software and then those results are validated using the conventional formulae for finding stresses in gear tooth.

3. Components

3.1 Metal Block

In metal block there are two holes are perpendicular to each other. One vertical hole is used to mounting the attachment to the tool post of lathe machine. Another horizontal hole is used for the stepped shaft. The both holes are made by boring operation.

Fig.3 Metal Block

3.2 Stepped Shaft

Fig.4 Stepped Shaft

Stepped shaft is installing in the metal block through the horizontal boring hole. Stepped shaft holds standard gear as well as blank gear on both ends. The stepped shaft is rotating in boring hole. It is also tightened by nut.

3.3 Spacer

Fig.5 Spacer

Spacer is use to prevent the blank gear from the impact of the chuck rotation. When the blank gear is directly contact with the tool it vibrates and this affect the too l as well as the blank gear. Spacer is providing perfect prevention of the blank gear from the impact of the lathe machine.

3.4 Tightening Nut and Bolt

Fig.6 Tightening Nut and Bolt

Tightening nuts and bolts are used to clamp the standard gear and the blank gear on the stepped shaft. This attachment also consist one spring holder, which holds the standard gear. This spring holder is also fixing by the bolts.

3.5 Drilling Cutter

Fig7. Drilling Cutter

Gear cutter or tool is fitted in the chuck. In this attachment the tool is rotate and the work piece is moveable on carriage. As per your requirement and type of thread you obtained the cutter is changed. This is drilling cutter. The form cutter is also use.

3.6 Standard Gear

Fig8. Standard Gear

Standard gear is fitted on the other end of stepped shaft. Standard gear is tightened by the nut. Standard gear is used for two purposes: first one is for the accurate dimension and second one is for fixing the blank gear.

3.7 Gear Blank

Fig9. Gear Blank

On which we have to make threads is called blank gear. The blank gear is fix on the stepped bar in direct contact to chuck. The blank gear is replica of standard gear.

4. Experimental Setup

Fig.9 Experimental Setup

Following fig. helpful for understanding the working of project. Working is similar to that of previous attachment i.e. Gear milling cutter with arbor is hold between two center of lathe machine and when power given to lathe machine it starts rotating which we want the cutting tool motion . The work piece is fitted on the Stepped shaft and this shaft is rotate in metal block when indexing is performed while cutting it remains in rest position. The standard gear mechanism which important for gear tooth production after equal interval. The shaft is in metal block can also be moved in vertical direction according to diameter of work piece and there is nut bolt arrangement is provided for locking of metal block in C channel. Feeding motion for this shaft is provided by the rotating the carriage wheel against the motion of cutting tool. Hence all motion is available for this attachment for gear making purposes. And we make here Spur as well as helical gear by using this attachment. For Production of helical gear we need tilting of bottom plate (as that of Taper turning) according to helix angle of gear. For Production of next teeth we have to disengage the screw and by rotating the shaft in metal block up to next hole of standard gear so that we lock this position for gear cutting by engaging the screw in that standard gear.

5. Results

Standard Gear		**Manufactured Gear**	
Pressure Angle	20^0	Pressure Angle	20^0
Teeth Number	30	Teeth Number	30
Pitch Diameter(mm)	70	Pitch Diameter(mm)	70
Module(mm)	2.333	Module(mm)	2.33
Diametral Pitch(mm)	0.428	Diametral Pitch(mm)	0.43
Circular Pitch(mm)	7.33	Circular Pitch(mm)	7.3
Addendum(mm)	2.333	Addendum(mm)	2.33
Dedendum(mm)	2.916	Dedendum(mm)	2.9
Tooth thickness(mm)	3.664	Tooth thickness(mm)	3.659
Clearance(mm)	0.583	Clearance(mm)	0.58
Outside Diameter(mm)	74.656	Outside Diameter(mm)	74.5
Bore Diameter(mm)	25	Bore Diameter(mm)	25
Total depth(mm)	10.625	Total depth(mm)	10.023
Working Depth(mm)	4.666	Working Depth(mm)	4.6
Base Diameter(mm)	66.425	Base Diameter(mm)	66.130
Root Diameter(mm)	64.158	Root Diameter(mm)	64.023

Table.1 Comparison of Gears

4. CONCLUSIONS

In this project we making attachment on lathe machine. We can also make gear on drilling machine because it present in all workshop and fabrication shop easily And rotating motion is available on spindle of drilling machine. Only there is problem in feeding of work piece against cutter. By improving drilling table we can also achieve this one.

1. Duty Center Lathe of standard Power 2.5 kW is capable of cutting spur gears.

2. Gears up to diameter of 30mm and module between 2 to 3 can be generated.

3. The profile comparison to the quality obtained is comparable to milling.

4. The attachment can be upgraded for machining mild steel gears.

5. The manufacturing cost of gear may be reduced by this method, which will be help full to small and medium industries.

6. REFERENCES

[1] Pal et al, "Studied on development of a back propagation neural network model for prediction of surface roughness in turning operation and used mild steel work-pieces."

[2] Thamizhmanii et al, "Studied on Applied Taguchi method for finding out the optimal value of surface roughness under optimum cutting condition in turning SCM 440 alloy steel."

[3] Shetty et al "Discussed the use of Taguchi and response surface methodologies for minimizing the surface roughness in turning of Discontinuously Reinforced Aluminium Composites having aluminium alloy 6061."

[4] Govind T Sarkar, Yogesh L Yenarkar and Dipak V Bhope, "Studied on the bending and surface stresses of gear tooth are major factor for failure of gear. Pitting is a surface fatigue failure due to repetitions of high contact stresses." International Journal for Scientific Research & Development| Vol. 4, Issue 09, 2016 | ISSN (online): 2321-0613

[5] Gadakh Ramesh, Londhe Pradip, Shaikh Bilal, Shaikh Firoj, "Studied about the lathe attachment on multipurpose machine for gear manufacturing." IJRET: International Journal of Research in Engineering and Technology eISSN: 23191163 | pISSN: 2321-7308.

[6] Kinematics of Machine, by B.L. Singhal and F. B. Sayyad, Ch.4, 5th Edition (Tech – Max Publication), (Page 4-2 to 4-7)

[7] Manufacturing Process-1, by A.V. Chirmule and M. D. Hasarmani, Ch.2, 1st Edition (Tech – Max Publication), (Page 242 to 2-49)

[8] Mechanical Measurement and Metrology, by H.G. Katariya and J.P. Hadiya, Ch.5, 3rd Edition (Books India Publication), (Page No. 142)

[9] Production Technology, by Dr. R. P. Arora, Ch.3, 1st Edition (Tech-Max Publication), (Page 3-8 to 3-53)